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V. *Notes on the Habits of some Hymenopterous Insects from the North-west Provinces of India.* By CHARLES HORNE, Esq., B.C.S., F.Z.S. With an Appendix, containing Descriptions of some new Species of Apidæ and Vespidæ collected by Mr. Horne: by FREDERICK SMITH, of the British Museum. Illustrated by Plates from Drawings by the Author of the Notes.

Read June 10th, 1869.

[PLATES XIX. to XXII.]

I HAVE been encouraged to arrange these Notes in consequence of the interest expressed on looking over my drawings by many of our leading entomologists, more especially by Mr. F. Smith, the well-known hymenopterist of the British Museum, who has so much assisted me in naming known and describing new species. The habits of some of these were little, if at all, previously known; and I trust that other students of nature, with more time at their disposal than I had in India, may take up this very interesting tribe of insects.

C. HORNE.

Upper Norwood, April 1869.

Fam. SPHEGIDÆ.

PELOPÆUS MADRASPATANUS, Fabr. (Plate XXI. figs. 6 & 7.)

This is perhaps the most common of the insects of this genus found in the North-west Provinces, India, and one which attracts the attention of the casual observer.

Its ordinary name amongst Europeans is the "mud-dauber." Its cells are found in the oddest places, but chiefly about the rooms of houses. They are generally constructed from June to October; and the insect is seldom to be seen at all after November, disappearing until the close of the cold weather, *i.e.* in February or March.

It may then be observed, but sparingly, as the individuals may be said to have emerged from the pupa-state before their time.

In May, June, and July, however, they may often be seen sitting by small muddy puddles near wells, working up the mud into little pellets about the size of buck shot, and then flying off with them in or, rather, under their mouths. These are taken to some corner of a window-sill, or hollow in a rough wall, and deposited on the spot which has been previously carefully selected by the insect. As it is perfectly fearless when engaged in cell-building, and as many of the positions selected are very open, it is easy to observe its habits.

This is one of the species which sometimes uses a cavity such as that left by the
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removal of a lock, a hollow between bricks, or between the wall and door-frame. Sometimes a roughness or slight depression in the floor is the unfortunate selection, where the first passer by will crush the construction, in which case the patient creature will rebuild it three or four times, and at last, in despair, abandon the locality; thus on one occasion I observed a cell built in the corner of the door-frame of a bath-room, so that it *must* be crushed every time the door was closed. The room was used at least once a day; and six times was the cell completely destroyed; it then abandoned the position. This was in October 1867; and I rather think that it ceased building merely in consequence of its season for cell-building having expired.

Sometimes each cell is separately constructed; at others one is placed over another; whilst I have observed them, as hereinafter described, build a mass of cells, as in the case of the corner of a room being selected.

The building of these cells is very regularly conducted, and they are generally placed parallel to the ground. A line of pellets of mud, the base of the cell, is first put down, and each pellet is worked nicely and smoothly with the jaws, assisted apparently by the feet, so that, as the work is performed very quickly, the joins are hardly perceptible. Having finished off its work with one pellet, it stands over it, looks at it with complacency, walks around it, pats it approvingly with its antennæ, and at last, being satisfied, flies off for more material.

I have reason to think that generally but one sex works at nest-building; for often, when I have captured an insect at work, no other has come to complete the structure.

A cell takes about a day to make, the insect working assiduously as long as daylight lasts. As the walls rise, layer by layer, they are contracted until they meet in an arch, the insect meanwhile carefully smoothing and plastering the interior as the work proceeds.

The next employment is the filling of the cell with food for the young grub. On one occasion only I observed *green caterpillars* being stored, although small field-spiders are the regular storing-food.

The egg would appear to be deposited on the body of the first spider placed in the cell. This would lead one to infer that the female is the worker.

Twenty spiders are sometimes packed away; and the egg or young grub of the insect has always been found by me on the lowest one when I have opened a cell directly after it has been closed up, which closing is effected directly the structure is well filled.

Ordinarily, on one cell being finished another is begun alongside, as little space being lost as possible; and in this way four, five, or six cells are made.

Meanwhile the egg is hatched, and the young grub sucks out, one by one, the juices of the comatized spiders, until being fully grown and its stores finished, it spins its strong cocoon of fine agglutinated silk and changes into the pupa-state. In this it remains for periods varying from one to five months according to season.

When the time for emerging arrives, the cap of the pupa-case gives way to the jaws

of the larva; and the earthen one of the cell (moistened at its edges by some fluid ejected by the insect) giving way, the *Pelopœus* comes forth fully prepared to mate, and build more cells. Of some of these cells I have observed the cap to be convex on the lower side, so that the least moisture or effort *internally* applied would loosen it, whilst external pressure would only fix it more securely.

I have never seen a sparrow or other bird attack one of these insects. Its sting and an odour it emits would appear sufficiently to protect it.

I forgot to mention that when the number of cells intended to be constructed in one place (generally two or three) is finished, the whole is covered with a smooth coating of mud, making it look like a dab of mud on the wall, and quite disarming the suspicions of the ordinary passer by. On one occasion I observed rays of mud round the nest, even more exactly imitating a lump of mud thrown with some force. This I hold to evince a most wonderful instinct, as they could not be required for strength.

PELOPŒUS BILINEATUS, Smith. (Plate XXI. figs. 14 & 14 a.)

This insect, which Mr. Smith has noted as a variety of *P. madraspatanus*, generally resembles it in its habits. It stores spiders, but it affects hedges and trees rather than buildings. A fork in the bough of a "Meendee" (*Lawsonia spinosa*), commonly used for hedges in the North-west Provinces, is often the favoured spot. Its structures are more solid than those of other species, which is the more necessary, as it has to resist greater stress of rain and weather.

PELOPŒUS BENGALENSIS, Dahlb. (Plate XXI. figs. 2 & 2 a.)

This insect rather affects the exterior than the interior of houses. In its general habits it very much resembles the last species, and it seldom, if ever, builds its cell separate. A rough wall or corner is its favourite place. It has even more than most *Pelopœi* the quivering motion of the abdomen, also common amongst Ichneumonidæ, and works very fast. Its work is rough, but is most carefully made to assume the form of the object on which it is built; for example, sometimes amongst grass the mud is continued up the stem for some distance, and the eye does not in consequence so readily determine the nature of the structure. The cells are well filled with small spiders.

My former remark, as regards the shape of the cell-doors of *P. madraspatanus*, applies equally to this species.

As there is an account of this insect and its works, in the 'Intellectual Observer,' by Mr. Beavan, I shall not offer any further remarks upon it. I, however, think that a note from my natural-history note-book, with a slight sketch, may prove of interest, and therefore subjoin it:—

"July 12, 1864.—This morning I broke open three cells neatly constructed on my door. I found the contents to be as separately represented, viz. one fed grub, one smaller one sucking a spider (which seemed to be his second, as a dry skin lay before

him), and twenty-five spiders of various sizes in the two cells. I could not find the egg or larva in the third cell, which had only just been closed; but the former was doubtless on the body of one of the larger spiders which had been first deposited in the cell.

"Benares."

It is very wonderful to see how well the food is packed, and it is worthy of inquiry how the stored spiders remain alive and *plump* for so many days. It must be the effect of the poison conveyed through the sting of the *Pelopaeus* when it captures the insect.

At times it builds its solitary, highly finished cell on some small hanging object, such as a stalk of grass in a thatch under shelter; and then the shape of the cell is curious, being rather ovate, so as to throw off the rain. At others the cells are placed side by side in great numbers, say twelve or fourteen, and so well covered over with mud as to be almost unobservable (Pl. XXI. fig. 2). The situation is very often in the midst of a plant of grass, the stalks of which are, as before observed, covered far up with mud.

Fam. CRABRONIDÆ.

TRYPOXYLON REJECTOR, Smith. (Plate XXI. figs. 4 & 4a.)

This curious little insect, when first hatched from the delicate little Serpularia-like cells, was taken by me for some parasite allied to the Ichneumonidæ, in consequence of my having often observed it hovering at the mouths of the cells of the smaller cell-building insects in my verandah. I found, however, that it brought mud and worked for itself, as well as appropriated the cells of other insects which it found ready to its hand.

I have nowhere found recorded its habits; but I think I have seen it carrying minute green spiders wherewith to fill its cells. It certainly does not feed its young, but stores food; for it closes its cells directly they are ready, which none of the Vespidae do.

The construction of these is very curious; and the pellets of earth used appear of a sandy character, which gives to the structure great delicacy and fragility. At the same time the interior of the cell is lined with some glutinous ejection which binds it together.

The specimens of cells figured (the originals of which are now all in England) show how strongly this cementing fluid acts. (See Pl. XXI. figs. 4 & 4a.)

The nests are extremely difficult to find, being small, and many straws hanging in the places where they are usually constructed, such as under a thatch of coarse grass.

As might have been expected, they remain a very short time in the pupa-state; and the month of September is their favourite season of construction, although they continue to build in October.

I have often watched them as I sat in my thatched summer-house at Mainpurí; and the rapidity with which they came and went was surprising. I know of no other special peculiarity which calls for remark, excepting that all the cells I have found have been under cover.

Fam. LARRIDÆ.

PARAPISON RUFIPES, Smith. (Plate XXI. figs. 1, 1a, 1b.)

This insect, which appears not to have been before noticed, has been described by Mr. F. Smith. It constructs a mass of loosely arranged cells of earth attached to some hanging object, such as a creeper, tendril, or pendent straw, or even a curled dry leaf. The interior of the cell is strengthened by a very fine glutinous silky-looking substance; and this is the more necessary, as the least damp would otherwise destroy the whole fabric.

I believe the insect to apply some kind of gluten, whilst the pupa secures its safety by spinning a very slight silken web within its abode. The cells are very globular, and are filled with the smallest spiders, of which I counted eighteen in two chambers. These are generally of a pale grey-green colour, and their plumpness is curious. Sometimes, however, it builds on walls with more or less regularity. (Vide Pl. XXI. figs. 1, 1a, & 1b.) The pellets used in construction are, comparatively with the size of the insect, very large, and loosely attached to one another: very little smoothing is effected exteriorly; and were it not for the interior binding together of the particles, the cell would apparently fall to pieces of itself.

A small *Pemphredon*, or another even smaller species, often takes possession of the cells of this insect, rendering the identification of the pupa very difficult. The chrysalis is more ovate in form than that of *Pemphredon*; I have no drawing of the grub.

The earth brought is prepared by water, as is the case with all clay-cell-building insects which I have observed; and the insect affects the vicinity of water, and hence probably is seldom found far from wells. It builds in September and October; and the perfect insect sometimes emerges early, although it often delays its appearance until the spring (viz. March or April) of the following year, when the heat sets in.

PISONITUS RUGOSUS, Smith. (Plate XXI. figs. 5 & 5a.)

This insect was most abundant in my court-house at Mainpuri. The door-posts had been made of old wood which were full of small and large screw-holes, which were used by it for the purpose of storing the tiny spiders which it provides for its larva.

As a proof that it can build with clay, although I never found its cells in any other position than in that above described, I may state that when the hole was too large for its purpose, it used to fill it in all round with clay, and closed the mouth of its cell with a similar material.

Fam. EUMENIDÆ.

EUMENES CONICA, Fabr. (Plate XX. figs. 2 & 2 a.)

As I bred many of these insects, I had ample opportunity of watching them. They place their nests on the walls of houses, but prefer wood, such as door-frames; while sometimes they make series of cells of great length, one such series often extending more than one foot.

One pair of insects will construct twelve or thirteen cells, and it does not take an entire day to complete one of them; yet I have often thought I could detect more than one pair engaged in one place, but at different ends of the structure, which, when completed, contained perhaps twenty-four cells.

It should be remembered that the insect avails itself of the wall or beam for the back of its cell, which is made extremely thin, the clay which is carried beneath the mouth being beautifully fine and well kneaded. Hence it is extremely difficult to detach their cells without breaking them. The cells are high and vaulted, and at the mouth they have a protruding rim, which projects outward and curves slightly downward. Ten or twelve *green* caterpillars are stored in each cell, which is carefully closed with mud.

This insect, like *Pelopæus madraspatanus*, seems very proud of its work, and, before leaving for fresh material, runs about approvingly and thoroughly inspects its performance. If disturbed it flies off, and does not attack you as do the Vespidae.

The imago generally emerges about five weeks after the cell has been closed; and, owing to the thinness of the walls, which are easily pierced, it is much attacked by parasites. Thus out of one group of five cells, only two specimens of *Eumenes* were hatched. Of these parasites I shall speak afterwards.

In life the *Eumenes* is much brighter in colour than it becomes after death, so that no idea of its beauty when at work can be readily formed from the specimens. It was from *one* of the cells of this species that I took nine caterpillars, eight of them being *black* Geometers, and only one *green* one; so that it is clear the insect had, contrary to custom, met with a brood of another colour which suited it quite as well as the *green*, which it generally uses.

EUMENES ESURIENS, Fabr. (Plate XX. figs. 6 & 6 a.)

This beautiful insect builds its cells about doors and windows, on the posts; and fig. 6 may be held to be a typical structure. As, however, I bred them from cells of different forms, there can be no doubt that they vary their style with the site. The cells are *high*, very spherical, and placed generally irregularly. *Green* caterpillars (chiefly Geometers) are stowed away, whilst one often finds the cells in the possession of a *Golden Wasp* (*Chrysis*), a parasite. The mouth of the cell resembles that of the other species in having a recurved lip, this being characteristic of this group. The reason why so many cells are empty after the escape of the perfect insect is, that the ants come in troops

and carry off the skins of the pupa-cases, and any fragment of food they can find, even to the skins of caterpillars and spiders. From the cells not only was one *Eumenes* hatched, but also a beetle of the genus *Emanadia* (*vide* Pl. XXII. fig. 1c), and a dip-terous insect, *Anthrax* — ?

EUMENES MAINPURIENSIS, Smith. (Plate XX. figs. 3 & 3a.)

This nest needs little description. It is beautifully made, has the recurved projecting lip like the rest of its congeners, and is constructed of the very finest earth. (*Vide* Pl. XX. figs. 3 & 3a.) The cell figured was empty; hence I cannot say positively whether it stores very small caterpillars. The insect much resembles *E. coarctata*, an English species; the cells also resemble those of the same insect. Figures are also given of *Eumenes edwardsii* and its nest (*vide* Pl. XX. figs. 4 & 4a).

ODYNERUS PUNCTUM, Sauss. (Plate XX. figs. 7 & 7a.)

This insect, like the others of its genus, avails itself of any hole of suitable size which it can find. In one instance I found a series of six cells (four of them empty, and in two of them dead insects) in the boring of a longicorn beetle; and I have often observed them taking green caterpillars into the holes left by large screws in door-posts. In the latter case, when the hollow is filled, the opening is covered over most smoothly *on a level* with the surface of the wood, so as often to escape notice; for this insect is in general a very neat worker. This covering is sometimes pierced with a hole as fine as that made by a pin, and thus the presence of the ichneumon larva is betrayed. When, however, it has more room, it most carefully fills up the entire space; and in the shape of the interior its cells are rounder than those of *Megachile*, being thus intermediate in form between them and those of *Eumenes*, which builds nearly circular cells.

These insects work in September and October, and in the latter month appear very actively spying for holes and filling them in when found. Their sting is very sharp; and they appear to affect green caterpillars, Geometers in particular; in fact I never found any other kind in their cells.

RHYNCHIUM CARNATICUM, Fabr. (Plate XX. figs. 5 & 5a.)

This insect is very abundant, and may constantly be observed carrying caterpillars to fill its cell, which is made in small hollow bamboos. In the illustration it will be seen that it has taken possession of a hollow in which a *Megachile lanata* had already constructed two cells. It first built a floor over the cells, which was constructed of mud, very finely worked, stout at the edges and thinner in the middle. It then left a space empty and made another floor, after which it commenced its breeding-cells. In these it stored caterpillars of many colours; and it finished off with an empty spare cell, which it covered with a heavy mass of pellets. The clay is kneaded very finely, and, although there are no sides to be made to the cell, the cap is most carefully constructed.

These insects are a very long time in undergoing their changes; and they vary much

in size and colour, doubtless in consequence of obtaining more or less food in their larva-state. Their sting is very sharp; but they do not attack one when disturbed, but fly off.

RHYNCHIUM BRUNNEUM, Fabr.

This insect in its habits resembles its associate *R. carnaticum*. It uses holes ready prepared—although, having seen it emerge from a gnawed hole in a soft post, the hole being the work of the insect, I believe it sometimes to work for itself in preparing a habitation. Its body is singularly flexible, so that it is almost impossible to hold it, when alive, without being stung by it.

RHYNCHIUM NITIDULUM, Fabr. (Plate XX. figs. 1 & 1 a.)

This extremely interesting insect constructs cells of exceeding strength, mostly upon timber. The clay is very finely worked with water and some kind of gum—not only viscid ejection being employed, but also the juices of the “Peepul” (*Ficus religiosa*), bird-lime in fact, and the gum of the *Acacia catechu* and other trees. Hence there is no need of thickness, and we accordingly find the walls of the chambers very thin, whilst their tenacity is so great that the portion of the hard wood on which the series of cells was fixed I have cut out with a chisel and hammer without in any way injuring the structure. One pair of insects does not usually make more than three cells; but it must be remembered that they take a much longer time in making them than does the rapid rough-working *Megachile*.

The food stored consists of caterpillars; and I have not yet succeeded in hatching a parasite from one of their nests, which are strong enough to resist all ordinary attacks. Until completed, either one or the other of the insects appears to remain at home (fig. 1); and hence parasites have no opportunity of effecting an entrance before the cell is closed over. The covering, though thin, is very tough, so tough that I doubt the power of a parasite to pierce it. In the figure it will be observed that six cells have been built one on another, only *one* being affixed to the door. This one was attached to a smoothly plane surface of “Sāl wood” (*Shorea robusta*); so that the cementing gum must have possessed great strength to allow me to cut it out with a hammer and chisel, as before alluded to.

These insects build on roof-beams, so that their nests generally escape notice, besides which they are far from common. They are externally of a rich brown colour, glistening with gum.

PTEROCHILUS PULCELLUS, Smith. (Plate XXI. figs. 8, 8 a, & 8 b.)

This little insect builds its parallel galleries on the nearly smooth surfaces of white-washed and other walls. The cells, as shown in the drawing, are above one another, lined with a gummy substance and fine *silk* (?) The chrysalis resembles that of *Pelopœus*, to which, however, the insect is altogether unlike. The clay must necessarily, from the

size of the insect, be very finely worked; and the food stored consists of very minute spiders. I have reason to believe that it sometimes builds its cells on hanging straws under shelter; but the example figured was found in my veranda, built on the walls or pillars, and attached to the plaster.

Fam. VESPIDÆ.

ICARIA VARIEGATA, Smith. (Plate XX. figs. 8, 8 α , & 9.)

This pretty little insect lives in small communities, and builds an elegant nest of paper prepared by itself, which is very tough, and attached to leaves, stalks, &c. by thin but strong pedicles. It frequents flowers, and appears to feed on pollen. The posterior segments of the body are very retractile, causing the abdomen to assume a curious truncated appearance. In the example figured on a stalk, the cell-mouths are all upwards, which is strange, as the young grubs, the mouths of whose cells are open to the weather, must need some protection. The same was in a great measure the case with the cells on the Mango leaf. The cells are beautifully regular, being perfect hexagons; and the strength with which the foot-stalk is fastened is surprising. There appears to be used for this portion of the work some kind of gum, with which they cover their plaster; and this much resembles varnish in appearance. It is probably derived from the Babool or Mango-tree, both of which abounded near Benares, where these nests were found. On one occasion I found a group of these little series of cells hanging in a covered tomb; they were attached to a stone slab, and all, of course, face downwards. Unfortunately they were old nests and quite empty. They consisted of a series of combs; and the number of cells in each averaged sixteen only. In this case shelter had evidently been sought, and in the two cases formerly noted the insects were in a measure shielded from the direct influence of the rain by the thickness of the foliage of the Mango-tree above them; for the habit of this *Icaria* is, as a rule, to build under shelter.

In their disposition like the rest of the Vespidae, they fly with one accord to attack the intruder—although their sting was not very sharp, and nearly resembled the prick of a fine pin, and was in a great measure deficient in the burning feeling experienced when stung by their brethren the *Polistidae*.

ICARIA FERRUGINEA, Fabr.

This insect in its habits resembles *I. variegata*. It feeds its larvæ with ejected juices; hence one never finds any thing but the egg slightly attached to the bottom of the cell, or the more matured grub, which spins itself a silken cocoon over its cell within which to change to a perfect insect. It associates in very large parties, and is extremely vicious when disturbed, and flies at the party interfering with it, hardly ever failing to

sting him. The pain of the sting resembles burning; and in one case of my taking a nest, when I was severely stung, the pain lasted for four days. I mention this as it is curious to observe the different degree of virulence of the poison of the various small insects of this class.

The cells extend in masses of great size, and are placed in the midst and amongst the twigs of thick garden bushes. I also believe, from what I have seen, that the comb of one season is *not* used in another; perhaps it becomes weather-worn and incapable of proper repair. This insect also has, like the *I. variegata*, a retractile body; and its cells are beautifully regular hexagons. It is much molested by a small class of moths (Tineidæ), and also by an *Anthrax*. In fact the nest lies very open to the attack of parasites, who, as a rule, care nothing for the sharpest stings. The grubs, which I found in abundance and in all stages of growth in October, have rather a singular shape, being almost conical. The perfect insects are much plagued with a species of *Stylops*, the females of which lie under the scales of the abdomen. I found one piece of comb nearly one foot across each way; but generally the combs are only one-half or two-thirds of this size.

POLISTES HEBRÆUS, Fabr.

This insect, which is generally known to residents in India as the "Yellow Wasp," is a great nuisance. It is very partial to verandas, and builds its cells on a roof-beam. More often, however, it selects trees near houses, and, if not disturbed, builds enormous nests, continuing year after year in the same place, deserting great parts of its comb as they become useless from age, and building others near to the old ones. The food of this insect is of a very general character, and it dearly loves sugar in any form.

It has an unpleasant habit of either flying at you if irritated, stinging you as it touches, and then flying on without stopping, or falling from above upon you and performing the same trick. I am told by a friend that the English Hornet does the same. In the case of the Indian *Polistes*, however, the sting is not very severe.

They sometimes select the oddest places for their combs. On one occasion I was moving some tin boxes, when about thirty flew out of one of them at me; and I found their comb in a corner, *inside*. They had obtained access through the open window of the store-room. I have often observed the commencement of a comb.

In the month of November the females newly hatched sit out on sunny days on the tops of venetian doors and similar situations and buzz for males. Nor do they wait long; for at this season the whole veranda swarms with these *Polistes*, and I have had thousands of them killed in a morning. Having met with a suitable partner, the ova appear to be impregnated; and not long after, the queen, fully prepared, sets to and builds a single cell on a stout foot-stalk, lays an egg in it, and proceeds to build three or four more around it, in each of which she lays an egg.

The young grow very fast, especially at first when so few have to be fed; and thus in a short time there is a well-peopled colony in which there will be a few males and workers of every size.

The tops of the cells of the queen wasps are much elongated with silk; and these insects use some species of gluten wherewith to temper the paper of which the cells are constructed, as well as to solidify the silken cell-coverings.

They are in the habit of seizing insects and sucking out their juices, wherewith they again feed the voracious young grubs, who are always clamouring for food with open mouths.

They are extremely troubled with *Stylops*, every fifth or sixth one taken having a female of one under one of the segments of the abdomen; and I have sometimes seen two or three on one specimen. I have often tried to breed these *Stylops*, but invariably failed, the male *Stylops* being very scarce, and the female, Mr. Smith tells me, never leaving the body of the *Polistes*.

This species is so well known that I do not think any further remarks are needed, excepting a short account of the methods by which these troublesome insects are most easily got rid of.

There is a yellow ant (*Ecophylla smaragdina*) which lives a social life, chiefly upon trees, drawing leaves together in a curious manner with silk, and making in this manner large nests in the Mango-trees. These insects sting severely, and they seem to have a great antipathy to the *Polistes*, who are very fond of feeding on their poorly protected juicy young grubs. If, therefore, you cut off a bough with a nest of these ants upon it, tie it to a long bamboo and put it very near to the nest of the *Polistes*, there will be a general attack by the former upon the latter. An ant will seize on a wasp and bite and sting him, others also coming up to help. They will together fall to the ground, when the *Polistes* dies, and the ant (*Ecophylla smaragdina*) having taken a sip of his blood and juices, runs up again to his nest by a string always left hanging down from the bamboo near to the nest for this purpose. They will also attack hornets. Their native name is "Mātā," and they are used by all classes for this purpose. No heat is too great for the *Polistes*; and in the hottest weather they may be found sitting in large parties by water, evidently enjoying the season.

These insects possess great vitality, of which the following is an instance:—

"Mainpuri, May 28, 1866.—Here is an instance of vitality. Last evening (7 P.M.) I caught a *Polistes* at the edge of my scissor-net, when the frames meeting took off his head. The body remained lively till half-past ten, P.M., when I went to bed; the wings vibrated, and the sting was constantly protruded; but next morning I found him cold and stiff. It is thus that many persons are stung; for they count the insects dead, and take them up unwittingly."

POLISTES STIGMA, Fabr.

This insect frequents sheltered places, such as the verandas of houses, and is extremely common. The description of the comb and the construction of its dwelling, as given under *P. hebraeus*, applies also to *P. stigma*. It does not, however, attack so viciously as some others, and stings only when much interfered with. Its cells are beautifully regular hexagons, and, although very light, are of the strongest fabric, being of a paper made by the insect. In its various stages it bears a great resemblance to *P. hebraeus*. August, September, and October are its favourite months for working, although it may be seen busily employed at most times during the rains.

Its food consists of small insects, which it eats and prepares for its young.

The cells of the females are longer than those of the workers and males, and their silken covers project much above the ordinary surface of the comb.

They are much troubled with *Stylops*; and I have occasionally bred from their combs specimens of small moths, chiefly of the Tineidæ, several species of which appear to be universal feeders.

VESPA VELUTINA, St. Farg.

This very handsome wasp builds a huge nest, hanging on the boughs of trees, mostly at a great height from the ground. Of its nest there are two handsome specimens in the nest-room of the British Museum. The communities are very numerous, and it is most dangerous to meddle with their nests. A bullet incautiously put through one brings down a swarm of the inhabitants, whose stings are most venomous and often dangerous to life. They will follow a party for miles through the densest jungle, and are said often to kill animals and, even, men.

A nest I measured exceeded 4 feet in length, and, when the outer covering was broken away, showed range upon range of cells; but the extreme difficulty of bringing it to England compelled me to abandon it.

They frequent flowers and carry off insects of all kinds wherewith to feed their young; and a wall covered with roses at a house in the Himalehs, 6500 feet above the sea, was a very favourite resort. They then flew off, often many miles, to their nests.

Appended (p. 190) is a description by Mr. Smith of an allied species (*V. virax*), apparently new, the habits of which are the same as those of *V. velutina*.

VESPA ORIENTALIS, Linn.*VESPA CINCTA*, Fabr.

The same notes will apply to both these species, which, I believe, to be already well known. They build their nests of prepared earth, strongly impregnated with some viscid substance, probably derived from the gums of trees.

In confirmation of the above, I may remark that I have often seen them sitting apparently eating the gum of the Acacia (catechu) and also the flowing juice of the Peepul

(*Ficus indica*), and, as they are in general carnivorous, it must have been for some such purpose. At the same time there appears to be some woody or, at least, vegetable fibre mixed with the earth.

The cells are regular hexagons, and built from an hexagonal *ground-plan*—a fact which confirms Mr. Smith's observations to the same effect; and the whole structure often assumes a large size. One found by me was $10'' \times 9'' \times 9\frac{1}{2}''$, in the centre of a wall composed of sun-burnt bricks, in a hollow which had originally been excavated by *Termites* and afterwards enlarged by the hornets, as they are popularly called.

I have often seen these insects pounce upon a sitting fly, just as a hawk would do on a small bird, and they are also very fond of ripe fruit, such as peaches, grapes, and apples. The *Vespa velutina* also indulges in these luxuries, and is especially fond of the hill-apricot.

The stings of four or five of these insects are said to be sufficiently powerful to kill a child; but, as in all such cases, much must depend on the circumstances.

The outside of the nest is, as is usual with wasps, covered with a coating of loose paper.

It is highly dangerous to disturb a colony of these insects; and as they work in gangs at night, it is somewhat hazardous even then to take their nests. As, however, they greatly affect outhouses, it is most necessary to destroy them, as horses have been said to have been stung to death by them; but for this I cannot vouch.

I will here quote *in extenso* from my note-book the notes which refer to Indian *Hornets*, by which terms both *V. cincta* and *V. orientalis* are designated, dated:—

“August 15, 1863.—These insects are very abundant at Benares, in India, but not generally spiteful. One may see hundreds of them flying round the sweetmeat stalls, like wasps in the fruit-shops in England; and the vendor drives them away with a whisk, a piece of palm-leaf, or a cloth, and is very rarely stung. If one, however, be inadvertently touched, the sting is very suddenly given and very sharp; its pain is intense, and it induces considerable inflammation. They make their nests in the mud walls; and the form of these is just like that of the English Hornet.

“Yesterday I was drying some sugar in the sun; and this attracted a large number of them. My man killed many, throwing down their bodies on the spot, when the ants appeared to carry off the carcasses; but not only did the ants so employ themselves, for the hornets alighted also and carried off their dead brethren as food! The ants (*Ecophylla smaragdina*) appear to be naturally very destructive to these insects. These ants live both in the ground and in nests made of leaves of trees drawn together.

“I have seen the hornets trying to carry off their tiny tormentors. Again and again have they darted at them; but it invariably ended either in the hornet quietly sitting down amongst his enemies to be bitten or stung to death and then carried off in triumph to be eaten by them, or in his falling to the ground with three or four ants hanging on, when his fate was equally certain.

"One of these insects stung me on the thumb; but by sucking the place for about a quarter of an hour I drew out the poison, and the pain and swelling were afterwards very slight.

"August 20, 1863.—This evening, having prepared two large squibs filled with damp gunpowder, I proceeded to take two nests, one of *V. orientalis* and one of *V. cincta*, both in similar situations. Having lighted the touch-paper, the end was placed at the mouth of the hole and wet clay was plastered around. The dense smoke and intense heat thus killed every perfect insect in the nests, which I shortly after dug out for the purpose of examination. One nest was buried forthwith in a hole previously prepared; and the one taken to be set up was that of *V. orientalis*, to which all the succeeding remarks will refer.

"Both nests were constructed of earth tempered with water, and I could trace no signs of gluten of any kind in them. In the nest prepared by me were seven ranges of cells; and at the time of taking it, from 400 to 500 hornets were at home. Although I took out every dead perfect insect, there were from forty to fifty nearly hatched by 5 A.M. next morning, showing with what enormous rapidity they increase. The nest was placed under a large wire dish-cover, and a nest of the yellow ant before referred to was placed with them, so that every young hornet was killed as soon as born.

"July 1, 1864, Benares.—As a boy, when in England, I have watched a hornet carry off a fly sitting on a door-handle; and to-day I saw one pounce on a small honey-bee deep in the pollen of a flower, and, taking him off, sit down and eat him quietly; and from the number hovering about flowers, this would seem to be a favourite food.

"July 19, 1864.—Watched hornets catching and eating the workers of *Termites*, whose galleries I had just destroyed on the bark of a tree, where, in consequence, the blind insects were running wildly about.

"August 19, 1864.—Watched them more narrowly and carefully. Saw that one caught at least ten *Termites*, one after the other, and made them all up into a ball with his jaws, when the said ball was taken away, evidently to feed the young larvae with a rich and juicy morsel, which, however, would be strongly tinctured with acid."

VESPA FLAVICEPS, Smith. (Plate XXI. figs. 10 & 11.)

This interesting little wasp lives in banks, making a cylindrical nest covered with party-coloured paper, and filled internally by layer upon layer of cells, seven or eight series generally completing the structure. They were found at Binsur, a mountain about twelve miles from Almorah, about 7500 feet above the sea, in nests about 2 feet under ground, and built up round some root.

The time of their greatest activity is in the rains (*i. e.* July), and they may then be seen coming in and going out of the nest in great numbers.

One of the nests taken was at the side of a garden-walk; and for some ten or fifteen days none could pass that way without a good chance of being stung. Although the

queen had been captured, they continued to build cells and repair the injuries done, very neatly uniting the broken bit of covering paper which had been left.

These wasps were often to be seen in flowers on the hill-side, and they appeared to feed freely on fruit and on insects found on the pollen of flowers.

The construction of the pillars of the nest was very neat, light and at the same time strong. No clay would appear to be used in the making of the cells, which were of regular waste-paper, the structure of which is of vegetable fibre.

I took many specimens from a nest in a bank on the footpath which led to the top of the mountain. At first they were very quiet; but after a day or two, directly any one approached they would fly at him if he stood but a moment near to the mouth of their nest. Their instinct of memory is most strange. Their stings are irritating, but not in any way dangerous to man, although it was by wasps of this species that a full-grown sheep belonging to a resident of Ranee Khet, near Almorah, was killed. The animal had doubtless trodden on an entrance to a nest, or pulled up some plant in feeding, and so disturbed them.

I had proposed to append a few notes relative to the parasites of these insects; but on second thought, I have briefly alluded to each in my notes on the species it affects. The genus *Chrysis* is largely represented; and there appears to be one of suitable size for each species of hymenopterous insect, so as to fit the cells.

Fam. APIDÆ.

LITHURGUS DENTIPES, Smith.

This insect in general appearance much resembles a *Megachile*; but its coloration is quite distinct. Its habits, however, are very similar, although the clay would seem to be in general worked smoother. A favourite position for placing cells is the gallery formed by the grub of some longicorn beetle in timber. In one case there were two entrances; and in consequence some of the cells had been constructed to face one way, and some the other, thus providing for the more comfortable exit of the perfect insect.

When considering the working of the cells of these insects, it is necessary to bear in mind the position in which they are placed: *e. g.* in case no. 12 the spirally twisted series is quite as rough exteriorly as those of *M. lanata*, whilst in cases 1 and 2, being pressed for room, the work necessarily appears smoother.

This insect seldom builds mud-daubs on the walls, and generally takes ready-made hollows for its building-purposes, although I have seen them working under the seat of a chair and on a rough part of a wall.

In all its habits it resembles *M. lanata*, and therefore no more remarks upon it will be called for.

MEGACHILE LANATA, Fabr. (Plate XIX. figs. 11, 11 *a*, & 11 *b*.)

This insect is found in almost every house in the North-west Provinces, and, next to the black and yellow *Pelopœus (madraspatanus)*, is the one which attracts most notice.

The season in which it builds its cells is from March to November; but July and August (*i.e.* during the rainy season) are its favourite months. These cells are placed in every conceivable situation; and it is curious, when sitting quietly writing, to watch the insect coming and going with his material. He or she is so deeply interested in the work that all fear is forgotten, and they will work within a foot of your writing-desk. The mud is carried, so to speak, under the head and in part supported by the fore legs, and is not so finely worked up as that of the *Pelopœus*; hence we find the work much rougher exteriorly, although the inside of the cell is carefully smoothed. I have had a newspaper lying on the table and heard them working inside the folds; in short there is no position too strange for the nest.

The following are a few of the positions in which I have found them:—

1. Between folds of paper; 2. in the back of a book which had been left lying open;
3. on the handle of a tea-cup; 4. in the keyhole of a door; 5. in the barrel of a gun;
6. under a fan on the table; 7. in the hollow of a bolt of a window, where three times the whole structure was crushed by the use of the said bolt in the absence of the insect;
8. on a signet ring from which the stone had fallen out; 9. on the frill of a large fan or punka, which was kept in motion ten or twelve hours out of the twenty-four.

I will now proceed with the method of working. Both sexes appear to labour; for I have sometimes caught a worker, and found that the work was immediately continued, which was not the case with the *Pelopœus*. They come and go incessantly, with a loud buzzing; and whilst they are tempering the clay they keep up the motion, thereby advertising the locality where they are working, although often the *exact* spot is even then difficult to find. The tenacity with which the clay adheres to substances is very curious (although the cells of the insects of the genus *Rhynchium* afford a better instance); and I believe that when the clay, having been first prepared at the water, is brought into use, it is inspissated with some glutinous substance ejected by the insect. It is certainly very carefully kneaded again by many of the clay-cell-builders. The cells are built side by side, with very little cohesion, and are stocked with bee-bread and closed by three or four pellets of mud, united in such a manner as to leave thin edges next to the lips or upper edges, and thus enable the insect easily to escape. The outside is in general rough and adapted to the situation in which it is built. It is scarcely ever truly circular on the outside, even if built free from obstruction.

Amongst the figures will be observed a solitary cell built in a signet-ring. The power of instinct shown here is very great; for to keep the cell secure the clay has been made larger at the base, where it projects interiorly in the ring.

This insect is very annoying from the manner it chokes up small openings, such as barrels of firearms and locks of drawers, in the latter case entering by the keyhole.

I watched the construction of four cells in June 1863; and the perfect insects were matured August 12, 14, 15, and 16 respectively. This would show, what is really the case, that the cells take about a day each to construct. In fact, in one case noted by me, a cell was commenced, finished, stored with food, and closed within certainly ten hours, which is quite possible if both sexes work, as I believe to be the case.

Sometimes, however, a hollow bamboo is the situation selected by this insect. If it be tolerably thick there is room for several cells; and they are built from the bottom of the hollow upwards, either in a straight line or spirally (*vide* Pl. XIX.). In either case I believe the single series to be constructed, and the second series commenced from the very bottom on the completion of the first. In some cases there are as many as eight or ten cells in each line; and probably more than one pair of insects are concerned in this double series.

And this leads me to one of the great difficulties in observing this class of insects. There are many parasites, one or two of which will be hereafter noted. Many, too, of the wasp class seize on cells and fill them with caterpillars or spiders, so that one sometimes finds one cell with bee-bread in it, and another, undoubtedly *made* by the same *Megachile*, filled with insects stored probably by a *Pelopaeus*.

There are also dipterous insects (*Anthrax*) who pierce the cell-cap and deposit an egg in the food, their larvæ feeding on the grub of the bee; so that when one keeps them to watch the insects emerge, most strange results follow.

Mr. F. Smith tells me that the lower cells of the series above mentioned in bamboos are those of females, which sex takes longer to develop, and that thus an exit is not required for them so soon as for the occupants of the upper cells, which are males. It had often puzzled me how this was managed.

MEGACHILE PROXIMA, Smith.

This insect is so similar to *Megachile lanata* that had I not caught one with a cut leaf of the *Clitoria* creeper in its mouth, and traced another to its burrows, I had held it to have been that insect.

Digging between three or four inches in the soft soil I found two cells one over the other. They were composed of these cuttings, four or five folds of leaf, and quite loosely put together. Within was a mass of bee-bread, with a young grub head downward in the midst. This grub was almost transparent, and cylindrical in form.

When opening one of the cells of this insect, I observed that it appeared to be lined with a finer and lighter-coloured leaf than that which constituted its external covering. Mr. F. Smith tells me that he found this to be the case with an English species (*M. argentata*); I have therefore held the fact to be worthy of note.

As I have observed a bee of this species entering a hollow bamboo of suitable diameter with a piece of leaf in his mouth, I have reason to believe that they avail themselves of such situations as well as of the ground. All this class of insects,

although generally consistent as to food, vary much, according to circumstances, in the places where they build their homes. Only one pair work together; and they are not at all social, although working often in the closest proximity.

MEGACHILE FASCICULATA, Smith. (Plate XIX. figs. 1-10.)

This fine bee may be observed on the rose-bushes, steadily cutting out portions of the leaf. Each portion is of the same shape, which may be observed in the figure of the leaf; and the work is done in a very rapid manner. There are long pieces and circular ones, the latter being for the caps of the cell. From their size, these bees are easily traced to their nests, which are placed in any suitable hollow; but their favourite position is between bricks in masonry in places where the mortar has fallen out, and I have often taken out series of cells laid side by side in long lines measuring seven or eight inches and containing perhaps fifteen cells each.

From observation, I should think that *one pair* of these insects will construct from thirty to forty cells. These cells are very nearly the size and shape of a common thimble; and some that I examined contained thirty-two pieces of leaf, being of seven thicknesses, besides three round tops each, placed one over another. The leaf employed was in this case that of the "urhur" plant, a large Indian pulse (*Cajanus indicus*) which grew in the field close by, and which is very soft and easy to cut; but in another instance, which is also figured with this paper, the material consisted of the leaves of the rose Edwards (*vide* Pl. XIX. fig. 7). This mass of cells, in which there are no less than seven series, was in the ornamental ear of a garden vase, into which I had observed the insect carrying leaves (*vide* Pl. XIX. fig. 1).

The cells are carefully constructed; and the interior pieces of leaf appear to be slightly cemented together by some fluid, ejected by the insect, of a gummy nature. The exterior leaves are quite loose, but hold firmly together on account of the manner in which they are dove-tailed, each one overlapping the other, as is clearly shown in the figure (*vide* Pl. XIX. fig. 4). Directly one cell is completed, a very large quantity of bee-bread is collected and stored, filling nearly half of it. The lining and exterior leaves of the cell appeared to be constructed of the same quality of leaf. An egg is then laid on the top, in the middle of the mass of food, from which the grub *emerges* a semitransparent cylindrical sac with a little black head. It rapidly increases in size, as shown in the Plate, where the subsequent changes being figured they need no further description. The head remains attached to the food, which, entering at the mouth, passes out as excrement above; this, when the grub spins its cocoon, is excluded. This spinning is effected after the larva has consolidated the inner surface of the cell with what looks like dark glue; and the said cocoon is an extremely tough one, and fit to resist the attacks of all parasites, by which these bees are much molested. Between the consolidation of the wall of the cell and the cocoon remain the exuviae, which, as before mentioned, have been voided upwards.

In the excrement of the Grey Hornbill (*Meniceros bicornis*) I have found the wings and body-plates of this bee, together with the remains of other species; so that it is clear that this omnivorous bird eats them, catching them probably when they come to feed on the juices of the broken figs (*Ficus religiosa*).

The changes take a long time; and as the construction of the cells is generally accomplished in October to November, the perfect insect does not usually come out until the following March, or even later.

Like all these bees, this species is perfectly fearless when engaged in building, and, from its strength and size, is not often attacked by any bird, although it is probable that the mice cut open the cells for the bee-bread, of which they are very fond. This has a sweet taste, mingled with a slight acridity, as has that of *M. lanata*, and would be fine feeding for mice, which abound in the localities generally chosen by the bee for its nest.

The concluding remarks on *M. lanata* will doubtless apply to this insect, as regards the precedence of emergence.

In a series of cells which I sent to England, taken immediately after construction, the insects came out irregularly; but this was owing to the fact that the occupants of some cells died, so that those below them had to eat their way out of the sides, which they could not have done had the said cells been *in situ*, and not packed loosely in a box with cotton wool.

[*Note*.—In my catalogue of Hymenopterous Insects, part 1. Andrenidæ and Apidæ, published by the Trustees of the British Museum, the male of this insect was described as a distinct species from the female; the former was named *M. fasciculata*, the latter *M. anthracina*.—FREDK. SMITH.]

MEGACHILE DISJUNCTA, Fabr. (Plate XIX. figs. 12 & 12 a.)

This insect in its habits agrees with *M. lanata*. In general appearance it is also very similar as regards form. The colour, however, is quite distinct, the broad band from which it takes its specific name being very marked. It makes clay cells separately, and also fills up the hollows of small bamboos with cells one over the other. In one instance I found four series of cells side by side in one bamboo; and in this case two of the cells had been appropriated by a *Pelopæus*—remains of spiders and the pupa-case of one of this genus being found in them. Their great enemies are the *Chrysidites*, or Golden Wasps; these take possession of the ready-made cells, and prey on the larvæ of the bee. They work at the same season as *M. lanata*, but are not so common.

XYLOCOPA CHLOROPTERA, St. Farg. (Plate XXII. figs. 1, 1 a, & 1 b.)

This fine bee may be heard buzzing in the veranda all day long, selecting hollow bamboos in which to store his bee-bread. The weight of this is surprising. That from one cell alone weighed 21 grains; and this was taken at random.

When once a suitable hollow has been selected, the insect begins to store food. The

female then lays an egg on the top of the same, and *both* male and female set to work gnawing at the interior near the mouth of the opening of the bamboo for saw-dust. This they work up with some viscous fluid which is ejected from the mouth, and form therewith a firm floor for the next cell. This floor is much thicker at the sides, where it joins the bamboo, than in the middle: the perfect insect, when emerging, has strong jaws, and his head is in the middle of the cell; he can therefore easily moisten and cut through this thin centre.

The cocoon is very strongly spun; and a long time elapses ere the perfect insect emerges. After all the work is finished (and these insects generally cease working at the end of October), they appear to retire into hollow bamboos to hibernate or die. Later on in the season I have opened bamboos and found six or seven, one after another, all dead; whilst at other times I have found them in a state of stupor caused by the cold. The young, I have reason to believe, do not come out until the spring. Their chief enemy is a species of *Cælionyx*, of which three were hatched, together with about fourteen bees, from one series of cells.

This species often burrows in soft "seenul" wood (*Bombar heptaphyllum*) (which is used in the building of outhouses), and can then be detected by the heap of coarse raspings under the hole. The bee-bread is very pleasant to the taste, with a slight subacid, and keeps good for a very long time. I am not aware that this bee ever works in living timber.

The insect in the larva-state is often destroyed by a minute Chalcididous insect of the genus *Eucyrtus*. From one single specimen I bred 300 of these insects; and two-thirds of those I tried to rear were destroyed by them.

"Mainpuri, July 10, 1865.—I was somewhat interested to-day in watching the shower of lovely yellow blossoms falling from a fine bush of a beautiful flower, and by observing how it was caused. I noticed the large black Bee (*Xylocopa chloroptera*) cutting the tube of the corolla, and inserting its tongue for the honey which abounded there; the flower immediately after fell; and amongst the hundreds on the ground I could not find one which was not so bitten."

XYLOCOPA AESTUANS, Linn.

The habits of this insect are so exactly like those of *X. chloroptera* that they need little further account. They use bamboos for their cells, and make divisions with raspings from the interior. I found three or four of these bees in company with three or four of *X. chloroptera* in the same hollow bamboo. When they cannot find a bamboo, they use any hole in a post or tree for the construction of their cells. I have also found them dead in bamboos, whither they had resorted to hibernate or die; but as their pupæ remain a very long time in their cases ere they emerge, the supply in any case is well kept up, and the insect is a common one. Various species of *Anthrax* and *Cælioxys* are their great parasitical enemies.

APIS FLORALIS, Fabr. (Plate XXII. figs. 2, 2 *a*, 2 *b*, & 2 *c*.)

This is a very interesting little bee, which builds its beautiful comb on the boughs of orange- and lemon-trees and garden bushes generally. The honey is much prized, and held by the natives to possess medicinal qualities. It is very harmless; and although I have handled them freely, I never remember to have been stung by one. I procured two queens by taking the nests with all the bees in them into a dark room with a small window; the bees gradually flew to the window, and I thus easily found the queen. The males are seldom with the nest; and out of some twenty I only met with them in two cases. I imagine they are driven out when they have performed their functions, as my gardener told me he often found them on and in the ground under the nests. In their general habits they entirely agree with *A. dorsata*; the only difference is that they select the inside of bushes, and loop their nest round the bough, instead of entirely hanging it on below. I have occasionally found nests of this species built in the interior of mud walls, in the cavities between bricks, or in the hollows excavated by *Termites*.

The wax is of a fine yellow colour; but so little of it is found as not to make it worth while to collect it for commercial purposes.

Their nests are infested by several moths, species of *Pampelia*, *Aphomia*, and *Galleria* having been bred by me from them.

APIS DORSATA, Fabr. (Plate XXII. figs. 3, 3 *a*, & 3 *b*.)

This is perhaps the best-known of the Indian honey-bees. It is extensively kept in a domestic state in the Himalayans, in hives generally consisting of hollow logs of wood built into the houses. Much honey is collected and brought for sale, especially at Petwaghur, in Kumaon; and the wax is also an article of trade. This bee, when in a wild state, is most savage in its disposition, and is very easily provoked, in which case it sallies forth in large parties, pounces on the supposed offender, and often causes great injury and annoyance.

The Moth (*Galleria mellonella*) will be hereafter described as a parasite; but its appearance in a large comb of three years' standing, and the consequent flight of the bees, gave me the opportunity of recording the following note:—

“ Nov. 13, 1866, at Mainpuri.—My head gardener, an intelligent man, came to me reporting that all the bees had swarmed off, leaving entirely deserted a very large comb of the common honey-bee, which was hanging to a branch of a tree. I at once proceeded to the spot, and, after examining the comb with a glass, found his statement to be correct. I also tracked the bees, which had alighted in a very large swarm on a tree about half a mile off. On cutting down the comb I found it to be $28\frac{1}{2}$ inches across by 22 inches, and nearly 5 inches thick at its thickest part. It was about three years old, as was plainly shown by the varied colour of the new ranges of cells.

	inches.
“ Measurements:—General breadth	$28\frac{1}{2}$
General length	22
General thickness	$1\frac{1}{8}$
Diameter of cell	$\frac{3}{16}$
Depth of honey-cell.	$1\frac{7}{8}$
Depth of ordinary cell	$\frac{10}{16}$ to $\frac{11}{16}$
Number of cells	21106
Honey cells, about	2000

“This nest had been deserted on account of the attacks of a Moth, figured in Pl. XXII. fig. 3c, which had fairly taken possession of the citadel, as I have often seen in other instances. The cocoons of some of the escaped moths protruded $\frac{3}{8}$ of an inch above the level of the comb, which, as it then was, still weighed three pounds.”

I remember at Bareilly, in 1856, as Mr. Berkeley was sitting in his veranda, on the roof-beam of which a comb of these bees was hanging, he saw them assembling in great commotion, and soon after *all* swarmed off. He sent me the comb forthwith, and I made careful notes upon it, which were destroyed in the Great Indian Mutiny of 1857. In this instance the comb was beautifully clean and semitransparent, one of the first year, and, held between the eye and the light, did not at first reveal any thing. The eggs were there, the seeds of destruction; and I watched it day by day till it all crumbled down into a mass of silk and exuviae, some forty or fifty moths having been meanwhile hatched therefrom. In this case it is clear that the bees fled at the *first* attack of the quiet little moths. But to return to the Mainpuri nest.

“The mouths of the thick new honey-cells were quite circular from the quantity of wax applied; those of the pupa-cells were hexagonal, as, of course, were the walls of the honey-cells interiorly. The Moth had deposited its eggs at the bottom of the cells prepared for storing honey; and the grubs were working their straight galleries in the flooring between the cells, always working at right angles, and at present feeding on the wax. As they proceeded they wove themselves silken tubes, probably for the purpose of protection.”

As, however, they grew larger and stronger they formed their galleries right through the cells, not touching the flooring-wax; and they then spun over the mouth of the cells and changed to the pupa-state. About sixteen moths had escaped from these pupa-cases which had been spun up in the cells and which protruded from them; and many caterpillars were *then* working within the comb.

The habits of these bees have been so often described, that I shall now only mention their plan of covering certain cells scattered over the comb, presenting a curious appearance on its face, which led me to examine them. On one side I counted 186 of such closed cells, and on the other 229, making a total of 415, which appears a large

number. I opened many of these, and found them to contain beautifully preserved remains of bees in various stages, whatever their age may have been at the time of death.

The grub of *Galleria mellolella*, the moth above referred to, is of a dull green, very circular, and somewhat tough; and it appears to eat the young bees, the bee-bread, honey, or wax, as may come most handy.

I will now give a few instances of their disposition:—

“A curious accident occurred at this place on Sunday last. A number of bees had built upon the cornice round the tower of the church of St. Paul’s, in the Civil Lines, just below the steeple. On Sunday, after the morning service, the bees, disturbed either by a pellet or a stone thrown into their midst, or from some other cause, suddenly attacked a pair of horses in a carriage and stung them so severely that both the animals died the next day. The coachman also was severely stung. It was considered unsafe to hold divine service in the church again that day.”—Agra, April 14, 1867.

On another occasion my camp was pitched at Sój, October 19, 1866, under a large Peepul tree. In the camp was my riding elephant, which animal is very fond of the leaves and small boughs of this tree. To enable him to enjoy them he was fastened under the tree, which he shook considerably in his endeavour to break off branches; this disturbed a nest of bees who had an enormous comb high on one of the branches. At first three or four bees came down to see; they flew back, and brought down some fifty or sixty with them: these did not attack the Elephant, but stung almost every one in camp, cattle grazing near, and even a stray dog, which I think they *killed*.

The strangest thing was that a man lying quite unprotected and fast asleep (named Cheda), clad with only a waistcloth, was quite unmolested; and I have often employed him to take the nests of aculeate hymenoptera for me, as they do not harm him, whatever he does. How is this to be accounted for? The natives say that he smells offensively to insects.

I will give two more instances. The bees, in February 1865, had formed their comb on a large tree near the old bridge (on the Grand Trunk Road at Mainpurí) over the river Esa, in a grove of trees at the road-side where travellers usually encamp when marching. My servants were so encamped when attacked by the bees, who had probably been disturbed by the smoke of their cooking-fires.

As Hindoos eat very lightly clad, they got sorely stung. One was nearly drowned in the river in his endeavours to keep under the water and so evade them; another ran between two and three miles, and was found by the villagers (who took him for a maniac) sitting on the ground throwing sand over himself.

It is generally an hour or two ere quiet is restored; and the pertinacity of the insects in following a person is very extraordinary. They espy the smallest bare spot and instantly implant their stings.

They also cause great annoyance, and disfigure old buildings, such as the Taj Mehal at Agra, with their pendent combs. Many vain attempts have been made to clear them

from the beautiful white marble arches; but as soon as a nest is destroyed it is renewed at a few feet distance. They sometimes choose cupboards to build their nests in; and when in one case they had made their comb in one in daily use, they molested no one. This was at Nynee Tal, in the veranda of a house called Maldon, now the Government House.

The manner in which these bees adhere, after having planted their stings, as compared with the habits of the *Polistes*, is worthy of note, although of course every one knows how often they leave their stings behind them in the wound, and thus meet their own death.

In one case of an attack by bees in the camp of Mr. B. W. Colvin, Magistrate, of Mainpuri, they looked, I am told, like a black mass of insects on the clothes on the backs of our men, upon which they had alighted; and in this case, I imagine, most of them were unable to withdraw their stings from the cotton-cloth jackets in which they had fixed them.

Besides the moth before alluded to, these insects have many enemies. *Merops viridis* (the Bee-eater) plays sad havoc amongst them; but in the hills, at least, the lizards, who live in the cracks of the rocks and in the hollows in the stone walls, are still more destructive.

Colonel H. Ramsay, C.B., the Commissioner of Kumaon, with whom I was staying last year, near Almorah, North-west Province, settled many hives in trunks of trees covered up with stones, but could make nothing of them by reason of the lizards, the large blue species so common in the Himalaya, probably *Tiliqua rufescens*. These animals would lie in wait and snap up the bees, regardless of their stings, as they alighted at the hive; in fact, they fairly destroyed several swarms.

Again, the Crested Honey-Buzzard (*Pernis cristata*), a small hawk, darts down on the comb and carries off a large portion in its claws, which, in spite of the bees, who fly at and attack it on all sides, it quietly eats on a neighbouring bough. How it escapes their stings I could never make out. I once also saw a nest of *Icaria* taken off a cornice just as I was preparing to secure it, having brought a ladder for the purpose; and these insects sting even more viciously than the bees.

Again, in the hills, as all know, the bears make prodigious efforts to get at the comb and honey when in trees. They also eat, I believe, the grubs and bee-bread; and although they seem annoyed, they care little for the bee-stings. These insects often hang their combs under rocks where no bear can touch them, and where they are also well sheltered from the weather.

Mr. F. Moore, of the India Office, has kindly and carefully compared the *Galleria* of the North-west Provinces with the specimen of the English species in the British Museum, and holds it to be the same insect, viz. *Galleria mellonella*—which is a very curious fact, the more so as this species extends over the whole of the North-western Provinces of India. The native name of this bee in the North-west Provinces is Dingār.

TRIGONA RUFICORNIS, Smith.

This is one of the smallest honey-bees I have ever met with ; and its habits are curious. I noticed it under the following circumstances ; and I never again met with its nest, although the natives all know it. One evening, at Benares (April 4, 1863), as I was standing at my door I saw a swarm of from 400 to 500 of what I took to be midges rapidly flying about in a mazy kind of dance, occupying a space of five or six feet, and being about ten feet from the ground. I brought out my insect-net and caught about a hundred in one sweep, when, to my surprise, they proved to be bees. On watching them I observed that they went in and out of a little hole in the wall close by, under a beam where was a hollow, and that many of their thighs were laden with pollen.

The insects seemed quite harmless, walking about my hand and not attempting to sting. Digging out some bricks with care, I came on a portion of their nest. The space it occupied appeared to have been originally eaten out by *Termites*. It was coated on all sides with a layer of black wax, and in it was stored their honey. The waxen cells were of a dark brown colour and very globular, pendent side by side from the roof, and not, as far as I could see, arranged hexagonally.

The honey was very dark in colour, but excellent in flavour ; and I was told by the natives that it possessed medicinal qualities. It had a slight astringency ; and, considering the size of the insect, the quantity stored was very large. I was also told that these insects commonly use hollow trees, in which they store astonishing quantities of honey, which is diligently sought for and highly prized. They called them "Bhōnga," which appears to me to be a generic name for *all* bees in the North-west Provinces. Large bricks prevented my digging further, so that I cannot describe their breeding-cells.

The bees continued to fly in the manner before described till dark, and did not desert their nest.

Note.—As when in India I refrained from capturing the domesticated bees, I had no specimens in my collection ; but from examples since obtained I have reason to believe that the species in general domestication is either *Apis indica* or *A. nigrocincta*. Both these species are much smaller ; and the comb made in the cupboard at Maldon, Nynee Tal, in 1849, was probably their work, as they prefer hollows of trees, or even crevices in rocks, as opposed to *A. dorsata*, which hang their combs from the underside of boughs of trees or rocks. All the notes above recorded, with this exception, apply to *A. dorsata*, whose savage disposition would seem ill to brook captivity.

APPENDIX.

[Seventeen new species are herein described: seven belong to the Fossorial Group of Hymenoptera, five belong to the Family Vespidæ, and five to the Apidæ.

The habits of eight species are more or less detailed in the Notes by Mr. Horne. The economy of the genera *Pison* and *Parapison* is for the first time made known; and considerable addition is made to our previous knowledge of the habits of several other genera, particularly of the species of *Pemphredon*, and also of the social Apidæ. Very little has been previously published on the habits of Indian Hymenoptera derived from actual observation.

The type specimens have been liberally presented by Mr. Horne to the British Museum.—F. S.]

Fam. POMPILIDÆ.

1. POMPILUS MACULIPES.

Female. Length $3\frac{1}{2}$ lines. Black, and thinly covered with cinereous pile; a white spot on the posterior tibiae near their base.

Head—the clypeus and cheeks bright and silvery in certain lights; the anterior margin of the former rounded; the tips of the mandibles ferruginous. The coxae beneath and the sides of the metathorax silvery bright, the latter rounded, smooth, and shining; the wings hyaline, the nervures black, with a fuscous cloud occupying the marginal cell and crossing the wing down to the posterior margin of the third discoidal cell. Abdomen smooth, shining, and pilose.

Hab. Mainpuri, North-west Provinces of India.

2. AGENIA MUTABILIS.

Female. Length $3\frac{1}{2}$ lines. Black, and covered with a fine changeable silvery pile.

Head covered with silvery pile, which is most dense and bright on the cheeks and clypeus, the anterior margin of the latter rounded; the palpi testaceous, the apical joints palest. Thorax silvery, most bright and dense on the coxae; metathorax rounded posteriorly, with a deep fossulet in the middle of its base, down the centre runs a marked or defined channel; the wings hyaline, the nervures black; the posterior femora bright ferruginous. Abdomen covered with a beautiful changeable silvery pile, its brilliancy changing in every fresh position, the apical segment very smooth and shining.

Hab. Mainpuri, North-west Provinces of India.

Fam. SPHEGIDÆ.

1. AMMOPHILA FUSCIPENNIS.

Male. Length $9\frac{1}{2}$ lines. Black, with red legs.

Head with scattered black pubescence, punctured, but not closely so; a little silvery pubescence on each side of the clypeus and above it as high as the insertion of the antennæ; the clypeus emarginate, the angles of the emargination prominent; the scape of the antennæ ferruginous. Thorax coarsely rugulose; the metathorax obliquely striated; wings fusco-hyaline, with a violet iridescence; the legs red, with the coxæ and claw-joint of the tarsi black. Abdomen black, the basal portion of the petiole more or less ferruginous; the rest of the abdomen with a fine silky pile, observable in certain lights.

Hab. Mainpuri, North-west Provinces of India.

2. PELOPÆUS CURVATUS.

Female. Length 6 to 7 lines. Black, variegated with yellow and ferruginous, the petiole black and curving upwards.

Head—a spot on the clypeus and the scape of the antennæ in front reddish yellow; the mandibles ferruginous near their apex. Thorax—a narrow line on the collar, the tegulæ, a transverse spot on the scutellum pointed at each end, and a spot at the insertion of the petiole on the metathorax yellow; the legs ferruginous, with the coxæ, trochanters, a line inside and outside of the femora, as well as the tips of the joints of the tarsi, black. The apical margin of the first segment of the abdomen with a broad reddish-yellow band; a narrow band of the same colour on the apical margins of the other segments; the abdomen curving downwards. The thorax transversely rugose, the metathorax most coarsely so; the wings hyaline, with the nervures bright ferruginous.

Hab. Mainpuri, North-west Provinces of India.

The form of the abdomen of this insect is the same as that of *Pelopæus deformis* from North China.

Fam. LARRIDÆ.

Genus PARAPISON.

The characters of this genus are in all respects the same as those of the genus *Pison*, excepting the absence of the petiolated second submarginal cell; it can therefore only be regarded as a division of that genus. Shuckard, in his Monograph on these insects, proposed a divisional name (*Pisonitus*). The following are the characters of the genus and its divisions:—

Gen. *Pison*. The eyes reniform; the anterior wings with three submarginal cells, the

second petiolated; the recurrent nervures either interstitial or both received by the second submarginal cell.

Gen. *Pisonitus*. The anterior wings with three submarginal cells, the second petiolated; the first recurrent nervure received towards the apex of the first submarginal cell, the second recurrent received about the middle of the second submarginal cell.

Gen. *Parapison*. The anterior wings with two submarginal cells, the first recurrent-nervure received towards the apex of the first submarginal cell, the second recurrent nervure uniting with the apical nervure of the first submarginal cell, usually known as the first transverso-median nervure.

In all these divisions the eyes are reniform, as in *Vespa*; and in all, the apical margins of the abdominal segments are more or less depressed.

1. PARAPISON RUFIPES. (Plate XXI. fig. 1 a.)

Female. Length 3 lines. Black, with the legs red.

Head—the cheeks, clypeus, and emargination of the eyes with bright silvery pile; the mandibles ferruginous, the palpi pale ferruginous. Thorax—the posterior margin of the prothorax and the sides of the metathorax with silvery pubescent pile; the mesothorax with a deep central longitudinal channel and a short impressed line between it and the tegulae; the metathorax has also a deep longitudinal channel, which is broadest and deepest at its origin at the postscutellum; the wings hyaline and iridescent; the legs ferruginous, with their coxae black, the apical joints of the tarsi dusky. Abdomen smooth, shining, and delicately punctured; the apical margins of the segments with changeable bright silvery pubescence; the sides of the abdomen very bright and glittering; beneath smooth and shining.

Hab. Mainpuri, North-west Provinces of India.

Fam. CRABRONIDÆ.

1. TRYPOXYLON INTRUDENS.

Female. Length 4-4½ lines. Black, with the second and third segments of the abdomen red, legs more or less testaceous.

Head shining and delicately punctured, with an impressed line in front of the anterior ocellus; the clypeus and the emargination of the eyes with bright silvery pubescence; tips of the mandibles ferruginous, the palpi pale testaceous; the extreme apex of the joints of the antennæ more or less rufo-testaceous. Thorax smooth and shining, with a few very fine punctures; the collar and sides of the metathorax silvery, the latter with a deep central longitudinal impression; a semicircular enclosed space at the base of the metathorax, which is transversely striated; the legs black, with the tips of the coxae, the trochanters, the base of the tibiæ, and the tips of the joints of the tarsi pale testaceous; the wings colourless and brilliantly iridescent. The petiole more than

half the length of the abdomen; the second and third segments red, with a fuscous spot in the middle of each.

Hab. Mainpuri, North-west Provinces of India.

This insect was bred from cocoons constructed by *Parapison rufipes*, it having taken possession of one of the cells and reared its own young therein.

2. TRYPOXYLON REJECTOR. (Plate XXI. fig. 4 a.)

Female. Length $5\frac{1}{4}$ lines. Black, with the second and third segments of the abdomen red, the legs black.

Head—the clypeus and the emargination of the eyes silvery; tips of the mandibles ferruginous, the palpi pale testaceous; an impressed line in front of the anterior ocellus, terminating at an elevated carina just above the insertion of the antennæ. Thorax smooth and shining on the disk; the sides of the metathorax with silvery pubescence, and a smooth enclosed space at its base divided by a central channel, beyond the enclosure it widens into a deep and wide fossule; wings subhyaline, their apical margins clouded and beautifully iridescent; legs entirely black. Abdomen with a long petiole, and smooth and shining; the second and third segments red, their apical margins more or less fuscous.

Hab. Mainpuri, North-west Provinces of India.

This species was bred from cells constructed by *Pterochilus pulchellus*.

Fam. EUMENIDÆ.

1. EUMENES MAINPURIENSIS. (Plate XX. fig. 3 a.)

Male. Length 5 lines. Black, with yellow bands and spots, and thinly covered with short pale pubescence.

Head and thorax very closely punctured; the clypeus and a narrow line running upwards and terminating in a round spot yellow; the apical joint or hook of the antennæ reddish yellow; the tips of the mandibles ferruginous. Thorax—the anterior margin of the prothorax yellow above; the tegulæ and postscutellum yellow; the tibiæ, tarsi, and apex of the femora yellow; the posterior tarsi, and apex of the tibiæ above, fuscous; the wings subhyaline, the anterior margin of the anterior pair more or less fuscous. Abdomen with all the segments irregularly bordered with yellow; petiole pyriform, the yellow border deeply emarginate in the middle, and on each side of it a deep impression; the second segment with a small transverse oblong yellow spot on each side, and the yellow border deeply emarginate in the middle and narrowed laterally; the borders of the other segments narrower; the abdomen is slightly shining, finely and closely punctured, but not so closely as the head and thorax.

Hab. Mainpuri, North-west Provinces of India.

This may possibly be the male of the species described by Saussure in his 'Mono-

graphie des Guêpes solitaires,' and named *Eumenes affinissima* from its close resemblance to the European species *E. coarctata* and *E. pomiformis*; but I have nothing to justify my considering it to be so.

2. PTEROCHILUS PULCELLUS. (Plate XXI. fig. 8 b.)

Female. Length 3 lines. Black, ornamented with yellowish-white markings; the basal segment of the abdomen red.

Head—a line behind the eyes, the sides of the clypeus, an oblong spot above it, the base of the mandibles and the scape in front yellow white. A transverse line on the thorax in front, the tegulæ, a spot beneath the wings, and the sides of the scutellum and postscutellum yellowish white; the wings hyaline and iridescent; the femora and the tibiæ within pale ferruginous, the coxæ white in front, the tibiæ and tarsi white and more or less stained with pale ferruginous. Abdomen—the first segment red, small, and campanulate, much narrower than the second; the posterior margins of all the segments white, and a small ovate spot on each side of the second segment; beneath, the second segment with a white apical margin.

Male. Rather smaller than the female, and closely resembling that sex, but having the clypeus immaculate (the female has a black spot), and the second abdominal segment without the two ovate white spots.

Hab. Mainpurí, North-west Provinces of India.

Fam. VESPIDÆ.

1. VESPA VIVAX. (Plate XXI. fig. 9, ♀.)

Worker. Length 9 lines. Black, pubescent, head yellow, the abdomen with orange bands, the legs and antennæ ferruginous.

Head sulphur-coloured; the face above the clypeus as high as the posterior ocelli black; the emargination of the eyes obscurely yellow; a reversed bell-shaped yellow spot between the antennæ.

Thorax black, with sometimes a very narrow orange line on each side of its anterior margin; wings fulvo-hyaline, with the anterior margin of the superior pair fusco-ferruginous; tegulæ rufo-piceous; the tibiæ and tarsi reddish yellow.

Abdomen with the first segment bordered with a broad orange band occupying half its width; the second segment with a very narrow orange band on its apical margin; the third segment yellow, with a quadrate spot on each side at its basal margin; these spots unite with the black basal portion of the segment, which is sometimes partly visible also; the apical margin of the fourth segment, and the fifth and sixth entirely, orange-yellow; the abdomen yellow beneath from the middle of the second segment to the apex.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species most closely resembles *V. velutina*, and must be arranged next to that species.

2. *VESPA FLAVICEPS*. (Plate XXI. figs. 10, ♀, 11, ♀.)

Female. Length 8 lines. Black, and ornamented with sulphur-yellow spots and bands.

Head yellow, with a small quadrate black spot that encloses the ocelli; the flagellum of the antennæ and the teeth of the mandibles black, the scape, and the vertex between the summit of the eyes, ferruginous; the eyes extending to the base of the mandibles. Thorax—the margins of the prothorax and of the scutellum, a spot on each side of the metathorax just above the insertion of the abdomen, and a spot beneath the wings yellow; the legs yellow and stained with ferruginous beneath; the coxæ, and the posterior femora at their base, more or less fuscous; the wings flavo-hyaline, the nervures ferruginous, the costal nervure fuscous. Abdomen—the first, second, and third segments with a yellow band on their apical margins; the bands on the second and third segments widen at the sides, where each is slightly emarginate; the two following segments are yellow, and have an ovate black spot on each side; the apical segment yellow beneath; the basal margins of the first, second, and third segments are black.

Worker. Length 6 lines. This sex differs from the female in many particulars. The vertex is black; the antennæ black, with the scape yellow in front. The thorax, legs, and wings as in the female. The abdomen has the apical margins of all the segments bordered with narrow yellow bands; the second and following segments have a rounded notch on each side. Beneath, the segments with yellow apical margins: that on the second segment is broad, and a curved black line runs into it, emanating from the black base of the segment; the margins of the three following segments have narrower bands, each having a black emargination on each side; very frequently there is a very narrow interrupted line of yellow at the base of the abdomen.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species has the aspect of one of our British, or one of the North-American Wasps; at first sight the workers look somewhat like those of *Vespa cuneata*.

3. *VESPA STRUCTOR*. (Plate XXI. fig. 12, ♀.)

Worker. Length 5 lines. Head and thorax black; abdomen reddish yellow, with black bands.

Head yellow, the vertex between the eyes black; the scape yellow in front; the eyes extending to the base of the mandibles. The margins of the prothorax, a line on each side at the base of the scutellum, the tibiæ, tarsi, and tips of the femora reddish yellow; the coxæ, trochanters, and base of the femora black; wings subhyaline, the nervures ferruginous, the costal nervure black. Abdomen reddish yellow, with the basal margins of the segments black; the black bands narrow, but widest in the middle,

and there produced into an angular point, and the posterior margins of the bands irregularly notched.

Hab. Binsur, Kumaon, North-west Provinces of India.

Fam. APIDÆ.

1. MEGACHILE PROXIMA.

Female. Length 6-7 lines. Head, thorax, and base of the abdomen with fulvous pubescence, the segments margined with white.

Head—the face clothed with fulvous pubescence; the thorax also with fulvous or fulvo-ferruginous pubescence above; the tegulæ ferruginous; the wings subhyaline, with a dark fuscous cloud beyond the marginal cell; the intermediate and posterior tibiæ with a fine silvery pilosity outside, and the basal joint of their tarsi with bright short ferruginous pubescence beneath. The basal segment of the abdomen with bright ferruginous pubescence; the posterior margin of the second with a narrow fringe of the same colour; the border on the third segment is reddish in the middle and white at the sides; the two following are edged with white; the apical segment is white on each side; the underside is clothed with silvery-white hair, with a fringe of black at the sides.

Male. This sex is coloured like the female, but has more of the red pubescence at the base of the abdomen, its anterior tarsi are simple, and the apical segment of the abdomen has no white at the sides, and its margin is notched in the middle.

This species very closely resembles the *M. lanata* of Fabricius, and is difficult to separate by description: the white pubescence on each side of the apical segment of the abdomen distinguishes the female; the males are alike; but both sexes of *M. proxima* are larger than those of *M. lanata*. The habits of the two species are totally different, as pointed out by Mr. Horne.

Hab. Mainpuri, North-west Provinces of India.

2. CÆLIOXYS ANGULATA.

Female. Length $5\frac{1}{2}$ lines. Jet black, the abdomen with a row of lateral snow-white angulated spots.

Head and thorax strongly and closely punctured; the face on each side of the clypeus and the anterior margin of the latter with dense short white pubescence, which also covers the head behind the eyes; a white line of pubescence on each side of the mesothorax close to the margins of the tegulæ, two minute spots of the same colour at the base of the scutellum; the thorax beneath, as well as the femora, with fine short white pubescence; the posterior tibiæ are also clothed outside; a stout tooth on each side of the scutellum; the posterior margin of the latter rounded. Abdomen shining, finely and sparingly punctured; a row of minute snow-white scales along the basal margin of the second and following segments, at the lateral margins an angular patch of the

same; the patch is quadrate on the basal segment; the apical segment broadly lanceolate, the lower plate of the same shape, and only a little longer than the upper one; beneath, the segments are margined with white, and usually more or less interrupted in the middle; the basal segment has a white patch in the middle.

Hab. Mainpuri, North-west Provinces of India.

This species is parasitic upon *Megachile fasciculata*, from the cells of which bee Mr. Horne bred it. In my catalogue of Andrenidæ and Apidæ I have described the female of *M. fasciculata* as a distinct species under the name *M. anthracina*; Mr. Horne bred both sexes from nests.

3. BOMBUS ATROCINCTUS. (Plate XXI. fig. 13, ♂.)

Male. Length 7 lines.

Head—the cheeks with griseous pubescence, the clypeus with white, on each side of it the pubescence is thin, long, and black, as it is also at the insertion of the antennæ, leaving the vertex naked, smooth and shining; there are also a few long black hairs on the posterior margin of the vertex. Thorax clothed above with fulvous pubescence, as are also the two basal segments of the abdomen; the wings fulvo-hyaline, with their apical margins fuscous; the third and fourth segments of the abdomen clothed with black pubescence, the three apical ones with white; the four apical joints of the tarsi ferruginous; the tarsi, beneath, have short bright ferruginous pubescence; the thorax and abdomen, beneath, with a long thin griseous pubescence.

Hab. Binsur, Kumaon, North-west Provinces of India.

This species resembles one of the varieties of the *Bombus lucorum* of Europe.

4. BOMBUS TERMINALIS.

Male. Length 7 lines.

The head clothed with black pubescence, that on the clypeus white and intermixed with some long bristly black hairs; the mandibles with a thick fringe of pale fulvous. Thorax clothed above with bright fulvous pubescence; that on the sides black; beneath it is white; the four apical joints of the tarsi ferruginous; the pubescence on the tibiæ black, intermixed with a few ferruginous hairs on the posterior pair; that on the tarsi beneath is bright ferruginous; wings fulvo-hyaline, the nervures dark ferruginous. Abdomen clothed with black pubescence; a few ferruginous hairs at its base, and the two apical segments clothed with white; beneath, the segments are fringed with pale hairs.

Worker. Length $5\frac{1}{2}$ lines. Clothed exactly the same as the male, and only differs in having the wings darker, and in not having white pubescence on the clypeus; above it, at the insertion of the antennæ, it is short, dense, and fusco-ferruginous.

Hab. The male from Simla.

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5. *TRIGONA RUFICORNIS.*

Worker. Length $1\frac{1}{2}$ line.

The head smooth and shining, the face with a white downy pubescence; the antennæ and mandibles ferruginous, the clypeus usually more or less so. The thorax smooth, shining, black; the scutellum and metathorax frequently more or less pale ferruginous; wings colourless and iridescent; legs pale ferruginous, varying in colour to dark fusco-ferruginous. Abdomen ferruginous, frequently dark towards the apex, and very smooth and shining.

Hab. Mainpuri, North-west Provinces of India.

DESCRIPTION OF THE PLATES.

PLATE XIX.

- Fig. 1. Nest of *Megachile fasciculata*, p. 178.
- Fig. 2. Male of *Megachile fasciculata*.
- Fig. 3. Female of *Megachile fasciculata*.
- Fig. 4. Leaf cells of *Megachile fasciculata*.
- Fig. 5. Open cell, with pollen, and grub feeding thereon.
- Fig. 6. The skin of the larva of *Megachile fasciculata*.
- Fig. 7. Leaves of a rose cut by *Megachile fasciculata*.
- Fig. 8. The pupa-case of *Megachile fasciculata*.
- Fig. 9. Larva of *Megachile fasciculata*.
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- Fig. 11. Nest of *Megachile lanata* (p. 176) in a piece of bamboo.
- Fig. 11 a. Female of *Megachile lanata*.
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- Fig. 12. Nest of *Megachile disjuncta*, p. 179.
- Fig. 12 a. Female of *Megachile disjuncta*.

PLATE XX.

- Fig. 1. Nest of *Rhynchium nitidulum*, p. 168.
- Fig. 1 a. The female of *Rhynchium nitidulum*.

Pages 195-196 are bound in between plates 21-22.

DESCRIPTION OF THE PLATES.

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PLATE XX.

- Fig. 1. Nest of *Rhynchium nitidulum*, p. 168.
- Fig. 1 a. The female of *Rhynchium nitidulum*.



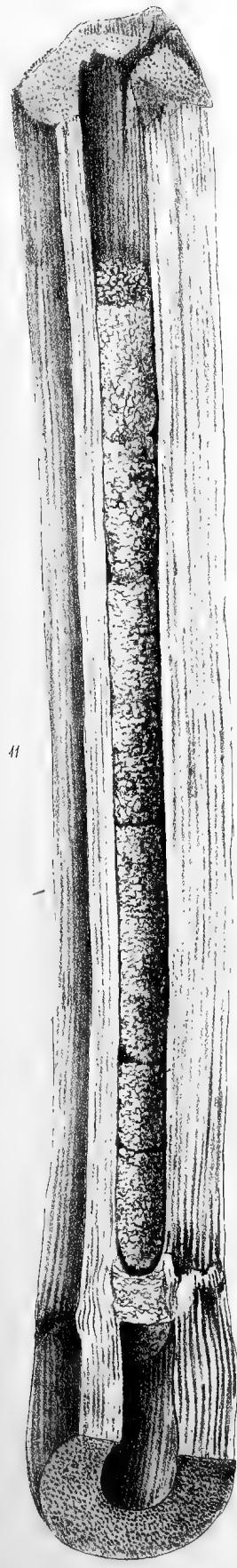
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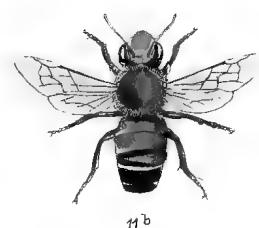
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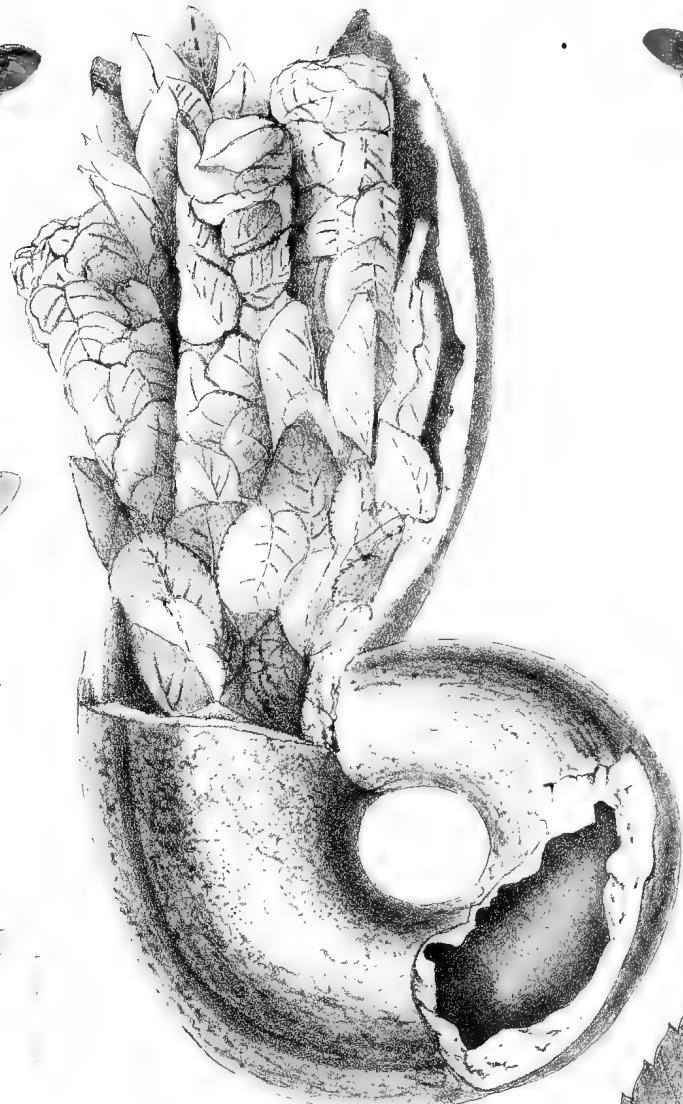
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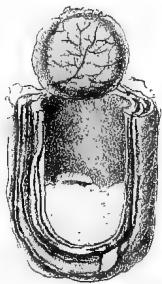
11a



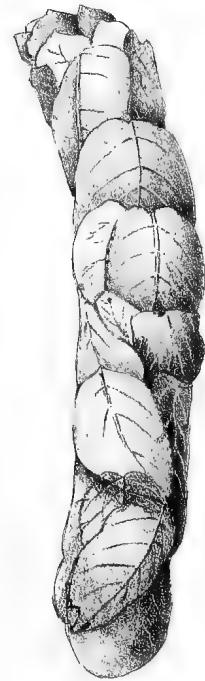
11b



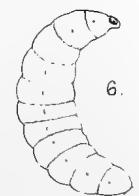
1.



5.



4.



6.



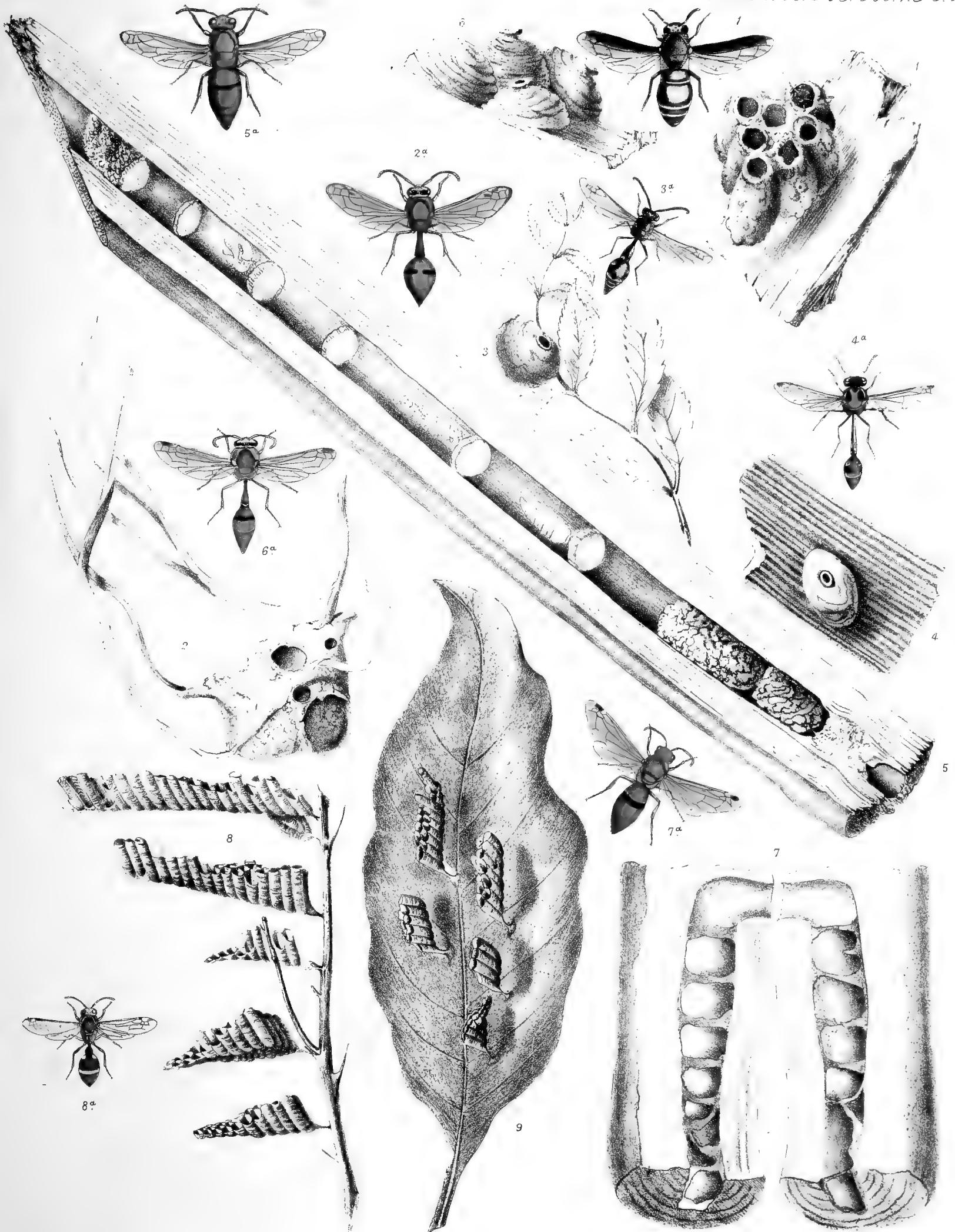
8.



7.



9.



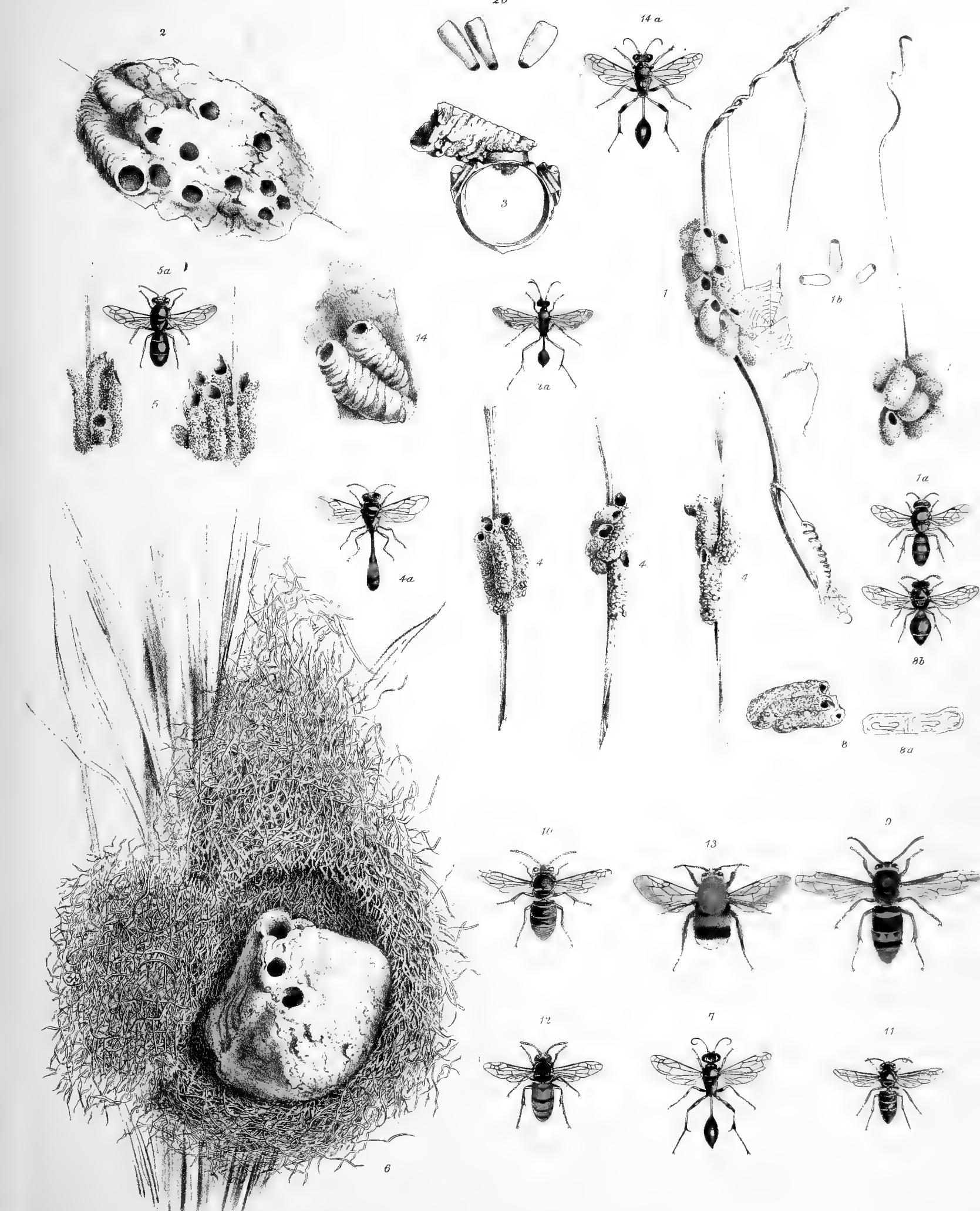


Fig. 2. Nest of *Eumenes conica* (abnormal form), p. 166.
 Fig. 2 a. Female of *Eumenes conica*.
 Fig. 3. Nest of *Eumenes mainpuriensis*, p. 167.
 Fig. 3 a. Female of *Eumenes mainpuriensis*, p. 189.
 Fig. 4. Nest of *Eumenes edwardsii*, p. 167.
 Fig. 4 a. Female of *Eumenes edwardsii*.
 Fig. 5. Nest of *Rhynchium carnaticum*, p. 167.
 Fig. 5 a. Female of *Rhynchium carnaticum*.
 Fig. 6. Nest of *Eumenes esuriens*, p. 167.
 Fig. 6 a. Female of *Eumenes esuriens*.
 Fig. 7. Nest of *Odynerus punctum*, p. 167.
 Fig. 7 a. Female of *Odynerus punctum*.
 Fig. 8. Nest of *Icaria variegata*, p. 169.
 Fig. 8 a. Female of *Icaria variegata*.
 Fig. 9. Nest of *Icaria variegata* on a leaf.

PLATE XXI.

Fig. 1. Nest of *Parapison rufipes*, p. 165.
 Fig. 1 a. *Parapison rufipes* (♀), p. 188.
 Fig. 1 b. Pupa-cases of *Parapison rufipes*.
 Fig. 2. Nest of *Pelopaeus bengalensis*, p. 163.
 Fig. 2 a. Pupa-cases of *Pelopaeus bengalensis*.
 Fig. 3. Cell of a species of *Pelopaeus* (?) constructed in a finger-ring.
 Fig. 4. Nest of *Trypoxylon rejector*, p. 164.
 Fig. 4 a. *Trypoxylon rejector*, p. 189.
 Fig. 5. Nest of *Pisonitus rugosus*, p. 165.
 Fig. 5 a. Female of *Pisonitus rugosus*.
 Fig. 6. Nest of *Pelopaeus madraspatanus*, p. 161.
 Fig. 7. Female of *Pelopaeus madraspatanus*.
 Figs. 8 & 8 a. Cells of *Pterochilus pulchellus*.
 Fig. 8 b. *Pterochilus pulchellus* (♀), p. 190.
 Fig. 9. *Vespa vivax* (♀), p. 190.
 Fig. 10. *Vespa flaviceps* (♀), pp. 174, 191.
 Fig. 11. *Vespa flaviceps* (♀).
 Fig. 12. *Vespa structor* (♀), p. 191.
 Fig. 13. *Bombus atrocinctus* (♂), p. 193.
 Fig. 14. Nest of *Pelopaeus bilineatus*, p. 163.
 Fig. 14 a. *Pelopaeus bilineatus* (♀).

PLATE XXII.

Fig. 1. Nest of *Xylocopa chloroptera*, p. 179.
Fig. 1 a. Female of *Xylocopa chloroptera*.
Fig. 1 b. Larva of *Xylocopa chloroptera*.
Fig. 1 c. *Emanadia*, sp. — ?, p. 167.
Fig. 2. Comb of *Apis floralis*, p. 181.
Fig. 2 a. The queen of *Apis floralis*.
Fig. 2 b. The worker of *Apis floralis*.
Fig. 2 c. The male of *Apis floralis*.
Fig. 3. Comb of *Apis dorsata*, p. 181.
Fig. 3 a. The worker of *Apis dorsata*.
Fig. 3 b. A closed cell of *Apis dorsata*.
Fig. 3 c. *Galleria mellonella*, a moth which feeds upon the comb.



